Asian Herpetological Research 2011, 2(4): 245–250
DOI: 10.3724/SP.J.1245.2011.00245

Abundance and Breeding of the Common Skittering Frog (*Euphlyctis cyanophlyctis*) and Bull Frog (*Hoplobatrachus tigerinus*) at Rawal Lake, Islamabad, Pakistan

Fozia TABASSUM, Muhammad RAIS*, Maqsood ANWAR, Tariq MEHMOOD, Iftikhar HUSSAIN and Shahid ALI KHAN

Department of Wildlife Management, *Pir Mehr Ali Shah Arid Agriculture University*, *Rawalpindi* 46300, *Pakistan*

Abstract The population density and breeding of two frog species, i. e., the Skittering Frog (*Euphlyctis cyanophlyctis*) and the Bull Frog (*Hoplobatrachus tigerinus*) were studied at Rawal Lake, Islamabad, Pakistan, by using visual encounter method from September 2009 to August 2010. Mean population density for the two frogs was 1.55 ± 0.44 frogs per ha, with that for the Skittering Frog being 1.09 ± 0.33 frogs/ha and that of the Bull Frog 0.46 ± 0.11 frog/ha, respectively. It is concluded that both frog species are explosive breeders, i. e., their breeding activities were confined to the first showers of the monsoon season. The mean spawn weight of the Skittering Frog was 1.5 g with more than 1000 eggs in each spawn, while that of the Bull Frog was 0.26 g with less than 1000 eggs in a spawn. The spawning sites of the two species were investigated in detail. Generally, no threat to their populations was observed. However, the opening of the spillway of Rawal Dam following the torrential rain destroyed the breeding sites of the frogs. It is maintained that the event did not produce any significant impact on their populations and breeding as the two species were quite common.

Keywords Ranidae, population status, breeding, habitat destruction

1. Introduction

Amphibians in Pakistan are represented by a single order Anura, four families (Bufonidae, Microhylidae, Megophryidae and Ranidae) comprising 26 species. The family Ranidae in Pakistan is represented by four genera, *Euphlyctis, Fejervarya, Hoplobatrachus* and *Sphaerotheca* (Dubois, 1992; Khan, 2006).

The Bull Frog (*Holobatrachus tigerinus*) is the largest frog found in Pakistan. It hibernates by burrowing in soil during winter as well as during the drought period (Khan, 1973). Breeding activity is primarily confined to monsoons (July-September). The color of breeding males is lemon yellow, while females remain dull colored. Against the yellowish white color of the throat of the males, their deep blue vocal sacs are prominent (Khan, 1969, 1996). The tadpole of the Bull Frog has a cylindrical body with a muscular tail (Khan, 1996).

The Skittering Frog *(Euphlyctis cyanophlyctis)* is a highly aquatic and littoral frog found in the plains and sub-mountainous areas of Pakistan. It remains permanently resident in different types of habitats with pooled water. Skittering over the water surface is its peculiar unique habit (Beveridge, 1979; Khan, 1996).

The decline of anuran populations has been reported globally during the last decade (Blaustein *et al*., 1994), with initial population crashes and mass localized extinctions having occurred in the early 1980s (McCallum, 2007). One of the most dramatic issues affecting anuran populations is habitat modification or destruction. Habitat fragmentation occurs when habitats are isolated due to modification, for example, when a small area of a forest is completely surrounded by agricultural fields (Knapp and Matthews, 2000).

The anuran fauna of Pakistan is not very diverse. Further, the assemblage has never been given much attention for research and conservation. Therefore, very little is known of the ecology and virtually no information

---

* Corresponding author: Mr. Muhammad RAIS, from the Pir Mehr Ali Shah Arid Agriculture University, Pakistan, with his research focusing on population dynamics, habitat studies and conservation of amphibians and reptiles.
Email: sahil@uaar.edu.pk

Received: 22 August 2011 Accepted: 14 December 2011

exists on the breeding of anuran population in Pakistan. The present study determined the abundance and documented some aspects of reproduction for the two frog species, the Skittering Frog and the Bull Frog.

2. Materials and Methods

2.1 Study area The Rawal Lake is part of the Margalla Hills National Park, and is situated in southeast of Islamabad City, Pakistan. It is the main source of drinking water for Rawalpindi City, in addition to providing a source for crop irrigation to surrounding areas. The Rawal Dam has been constructed on the Kurrang River, the main source of water to the Rawal Lake, having a catchment area of 274.53 km^2 with a total storage capacity of 47 500 acre-feet (PEPA, 2004). The total area of the lake is 19.02 km^2 with a buffer zone of 2 km^2. Average annual rainfall is 1000 mm and temperature ranges between 1–15°C in winter and 20–40°C in the summer (Hussain *et al.*, 2002). The lake is significant from a recreational point of view and also buffers against floods.

2.2 Sampling sites Three sampling sites were selected after a reconnaissance survey, with the sites being surveyed regularly from September 2009 to July 2010 for data collection twice a month. However, the visits were conducted more frequently during summer and during the rainy season. Sampling site I (sampled area = 5 ha; 33° 41’ 51’ N and 73° 07’ 41’ E) is located at the Rawal Dam Spillway, having a stony ground (Figure 2A); sampling site II (sampled area = 7.5 ha; 33° 41’ 30’ N and 73° 07’ 53’ E) also had stony ground (Figure 2B); and sampling site III (sampled area = 14 ha; 33° 41’ 39’ N and 73° 07’ 80’ E) was covered with croplands along a canal carrying water from the Rawal Lake for irrigation and farming purposes near Bani Gala Village and National Agricultural Research Centre (Figure 3A, B). The dominant grasses of these sites include Madhana (*Paspalidium flavidum*), Khabbal (*Cynodon dactylon*) and a herb locally called Gandi Buti (*Parthenium hysterophorus*).

2.3 Estimation of population density Two species, *E. cyanophlyctis* and *H. tigerinus*, were selected for this study and their taxonomy and species identification was determined following Khan (2006). Visual encounter surveys were conducted along a single transect within each sampling site for estimating population density. The surveys were undertaken in the evening hours. A thorough search was made using torch lights, and all the anuran refuges such as vegetation, logs, stones and water were eye scanned. The number of individuals of any given species and time spent were noted (modified from Campbell and Christman, 1982; Heyer *et al.*, 1998; Fellers *et al.*, 1995). For each sampling site, the area was calculated by multiplying width of the transect with the length of the transect, and population density was determined by dividing number of individuals with the area.

2.4 Breeding Aspects analyzed included time of breeding, spawn size (weight and number of eggs), spawning site (temperature, humidity, water depth and dominant vegetation), and sex ratios during breeding. The time of breeding for each species was recorded by observing and recording advertisement calls for frogs and other breeding activities such as egg laying. Spawns were hand-picked, weighed using a balance and returned to the site of egg deposition. Eggs were counted and divided into three categories, i. e., below 500, 500–1000, and above 1000 eggs. Air and water temperatures were recorded using a thermometer, depth of water was recorded using a measuring scale, and plants were sampled, dried, kept in a plant presser for later identification. Number of amplectants, and free males and females were noted to calculate sex ratio.

3. Results

3.1 Population density In total, 496 individuals of both the Skittering Frog and Bull Frog with a mean population density of 1.55 ± 0.44 frogs per ha were recorded from the Rawal Lake. Of the recorded individuals, 102 were recorded at site I, 119 at site II and 275 at site III. Maximum population density of 5.16 frogs per ha was recorded during May 2010, while no frogs were recorded during January, February or August, 2010 (Table 1).

As many as 349 individuals with 1.09 ± 0.33 Skittering Frog per ha were recorded. Of these, 56 were recorded at site I, 63 at site II and 230 at site III. Maximum population density of 3.96 frogs per ha was recorded during May 2010, while no frogs were recorded during January, February and August, 2010 (Table 1).

A total of 147 individuals were observed for the Bull Frog, with a density of 0.46 ± 0.11 individuals per ha. Of these, 46 were recorded at site I, 56 at site II and 45 at site III. A maximum population density of 1.20 frogs per ha was recorded during May 2010, while no frogs were recorded during January, February and August, 2010 (Table 1).

3.2 Breeding of the Skittering Frog and Bull Frog The mean spawn weight (n = 10) of the Skittering Frog was 1.5 g with over 1000 eggs in each spawn. Mean air and

Table 1 Population densities (frogs per ha) of the Skittering Frog and Bull Frog recorded from Rawal Lake from September, 2009 to August, 2010

		Skittering Frog					Bull Frog					The two frogs combined				
Year	Month	Site I	Site II	Site III	Total individuals	Population density	Site I	Site II	Site III	Total individuals	Population density	Site I	Site II	Site III	Total individuals	Population density
2009	Sep	2	5	14	21	0.79	5	4	2	11	0.41	7	9	16	32	1.2
	Oct	1	3	9	13	0.49	3	3	1	7	0.26	4	6	10	20	0.75
	Nov	4	3	16	23	0.86	2	1	3	6	0.22	6	4	19	29	1.09
	Dec	1	4	18	23	0.86	3	2	5	10	0.37	4	6	23	33	1.24
2010	Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mar	7	4	17	28	1.05	7	4	5	16	0.6	14	8	22	44	1.66
	Apr	10	3	39	52	1.96	6	6	5	17	0.64	16	9	44	69	2.6
	May	16	21	68	105	3.96	7	15	10	32	1.2	23	36	78	137	5.16
	Jun	12	13	40	65	2.45	8	15	5	28	1.05	20	28	45	93	3.5
	Jul	3	7	9	19	0.71	5	6	9	20	0.75	8	13	18	39	1.47
	Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	56	63	230	349	13.16	46	56	45	147	5.54	102	119	275	496	18.71
	Mean	1.09 ± 0.33					0.46 ± 0.11					1.55 ± 0.44				

water temperatures at the breeding sites were 28 and 26.6 °C, respectively, with a mean water depth of 0.54 m. The sex ratio (male : female) during breeding season was found to be 1.15 : 1 (Table 2).

The mean spawn weight (n = 10) of the Bull Frog was 0.26 g with less than 1000 eggs in each spawn except on one occasion. Mean air and water temperatures at the breeding sites were 28°C and 26.6°C, respectively, and mean water depth was 0.23 m. Sex ratio (male : female) during breeding season was found to be 1.27 : 1 (Table 3). The spawning sites of the both species were characterized by grasses with *Paspalidium flavidum* as dominant species. Average morning and evening humidity during July 2010 were 72% and 45% and 78% and 49% for August 2010, respectively.

Eggs were not laid in the deeper layer of the water body, rather they were laid along the margins, and the eggs initially floated and then sank. The Skittering Frog preferred shallower water for egg deposition. Both species showed explosive breeding, i. e., breeding was confined to first splashes of monsoon (Figure 4).

4. Discussion

Seven genera of the Family Ranidae occur in Pakistan (Dubois, 1992). Of these, two species, *Hoplobatrachus tigerinus* and *Euphlyctis cyanophlyctis*, are quite common in the Punjab Province, Pakistan. The assessment of amphibians in Southeast Asia showed that 77 species were evaluated as data deficient and more than 100 others were not evaluated (Molur, 2008). This is due to a general lack of research dealing with the estimation, assessment and monitoring of amphibian populations in this region. Such quantitative studies on amphibian abundance are also lacked in Pakistan. Yousuf *et al*. (2010) recorded mean population densities of ranid frogs (*H. tigerinus* and *E. cyanophlyctis* combined) as 25.07/ha from the paddy fields of Gujranwala, Punjab Province. Sluys *et al*. (2001)

Table 2 The selected aspects of breeding of the Skittering Frog recorded from the Rawal Lake

Spawn size					Spawn site				Sex		
No. of spawns	Weight (g)	No. of eggs			Temperature (°C)		Water depth (m)	Vegetation	No.		Ratio
		Below 500	500-1000	Above 1000	Air	water			♂	♀	♂ : ♀
2	1.6			+	28	26	0.60	*C. dactylon*	7	5	1.40:1
3	1.5			+	28	27	0.60	(Khabbal Ghas)	3	4	0.75:1
3	1.56			+	28	27	0.60	*P. hysterophorus*	9	7	1.28:1
2	1.5			+	26	25	0.60	(Gandi Buti)	6	5	1.20:1
	Tadpoles	+			30	28	0.30	*P. flavidum*	7	6	1.16:1
Total = 10	Mean = 1.5				28	26.6	0.54	(Madhana Ghas)	32	27	1.15:1

Table 3 The selected aspects of breeding of the Bull Frog recorded from the Rawal Lake

Spawn size					Spawn site				Sex		
No. of spawns	Weight (g)	No. of eggs			Temperature (°C)		Water depth (m)	Vegetation	No.		Ratio
		Below 500	500-1000	Above 1000	Air	water			♂	♀	♂ : ♀
2	0.24		+		28	26	0.30	*C. dactylon*	5	4	1.25:1
3	0.30			+	28	26	0.30	(Khabbal Ghas)	9	7	1.28:1
2	0.26		+		28	26	0.30	*P. hysterophorus*	7	6	1.16:1
2	0.25		+		26	25	0.30	(Gandi Buti)	14	10	1.40:1
1	0	+			30	28	Dry	*P. flavidum*	0	0	-
Total = 10	Mean = 0.26				28	26.6	0.30	(Madhana Ghas)	8.75	6.75	1.27:1

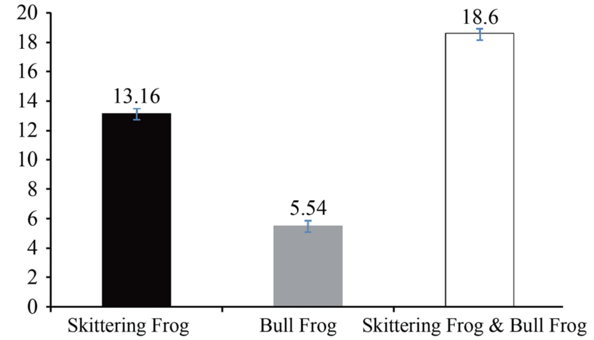

Figure 1 Comparison of the population densities of the two frog species recorded from the Rawal Lake from September, 2009 to August, 2010.

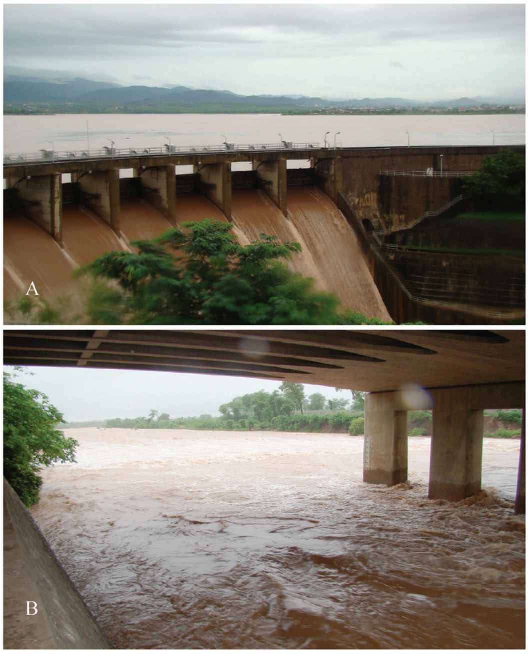

Figure 2 Sampling site I (A: After opening of the dam's spillways) and sampling site II (B: After flooding).

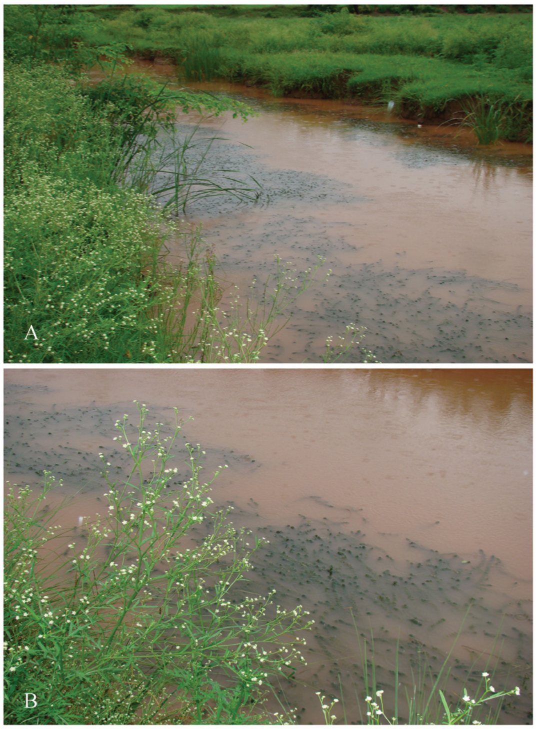

Figure 3 Sampling site III (A, B).

recorded 42 individuals of the Leptodactylid Litter Frog (*Zachaenus parvulus*) with an estimated population density of 9.0 frogs/100 m^2 and estimated biomass of 13.5 g/100 m^2 in the Atlantic rain forest on the Ilha Grande Island in southern Estado do Rio de Janeiro, southeastern Brazil. In comparison with the aforementioned studies, the present study revealed low population densities of *H. tigerinus* and *E. cyanophlyctis* due to different ecosystems and survey methods. It is, however, concluded that both the frog species (18.6/ha) are common at the study area, with the Skittering Frog (13.16 /ha) being much more common than Bull Frog (5.54/ha) (Figure 1).

Sluys *et al*. (2001) recorded male and female of *Zach-*

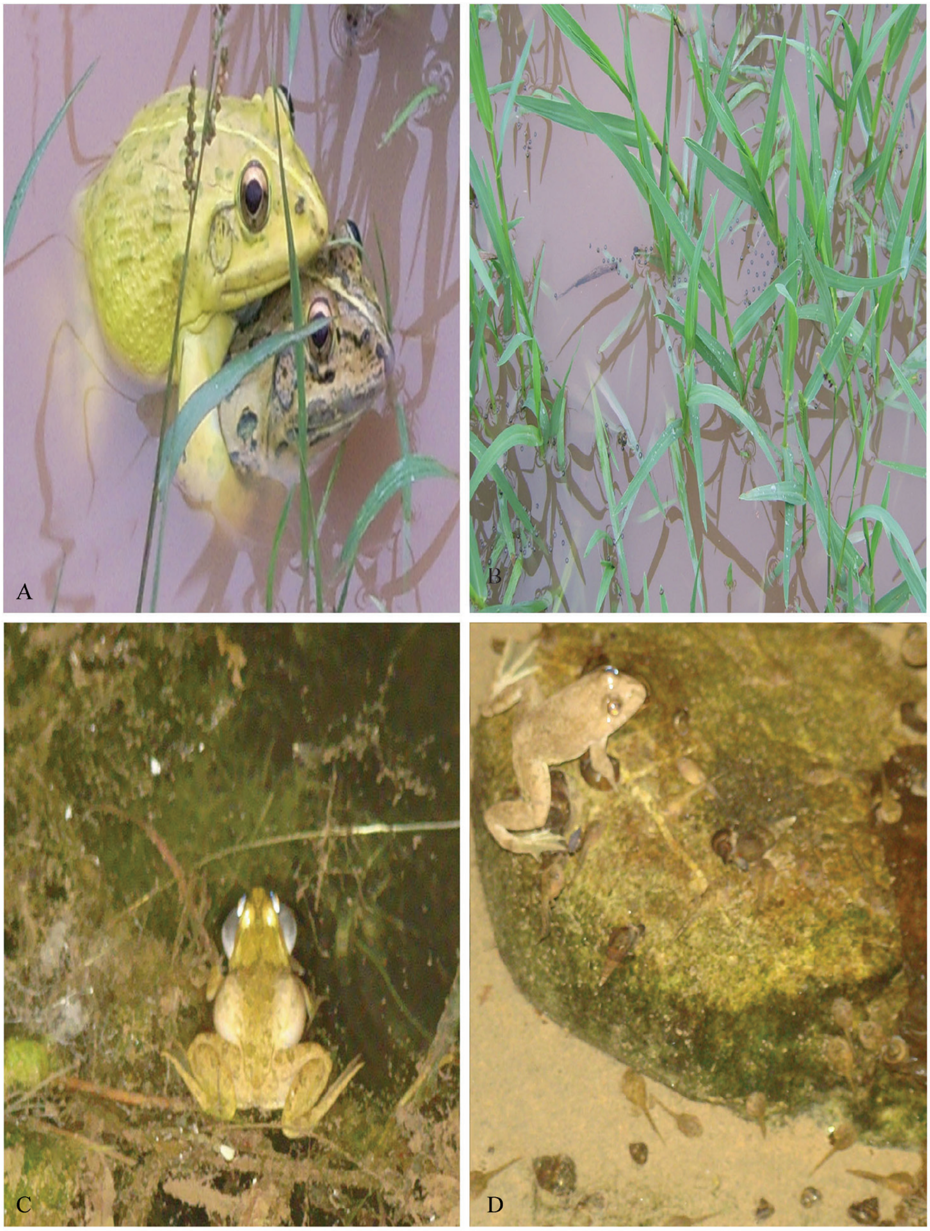

Figure 4 The Bull Frog in amplexus (A), eggs of the Bull Frog (B), the Skittering Frog with tadpoles (C, D).

aenus parvulus in the ratio of 1.3:1 from Atlantic rain forest, southeastern Brazil. The sex ratios (male : female) of *H. tigerinus* and *E. cyanophlyctis* were 1.27:1 and 1.15:1, respectively during the present study. The comparison revealed that most frog species have similar sex ratios wherein males are relatively more abundant.

Two basic patterns of anuran reproduction have been recognized, including prolonged and explosive breeding. Explosive breeding takes place over a period of a few days to a few weeks, and prolonged breeding occurs over a period of more than a month (Wells, 2007). The present study concluded that both frog species showed explosive breeding, i.e., breeding activities were confined during monsoon period (July–August), particularly the first spell of the rains. Rombough and Hayes (2007) observed several attempts of physical and non-vocal competition between males of *Rana boylii* for females by displacement of amplectant male, and suggested that the males of this population actively seek out and physically compete for females. Similar behavior was observed in the males of the Skittering Frog and Bull Frog during the study.

The opening of the spillways of the Rawal Dam on

29 July 2010 destroyed breeding sites for the frogs. It is, however, maintained that the event did not produce any significant impact on their populations and breeding as the two species were quite common after the event.

References

Beveridge A. S. 1979. Babur-Nama. Lahore: Sang-e-Meel Publications

Blaustein A. R., Wake D. B., Sousa W. P. 1994. Amphibian declines: Judging stability, persistence, and susceptibility of populations to local and global extinction. Conser Biol, 8(1): 60–71

Campbell H. W., Chiristman S. P. 1998. Herpetological Communities, Wildlife Research Report 13. Washington, D. C.: U.S. Fish and Wildlife Service, 193–200

Dubois A. 1992. Notes surla classification ranidae (Amphibian Anoures). Bull Mens Soc Linn Lyon, 61(10): 305–352

Fellers G. M., Freel K. L. 1995. A standardized protocol for surveying aquatic amphibians. U. S. Dept of Interior, National Park Service Technical Report NPS/WRUC/NRTR-95-01, 117–172

Heyer W. R., Rand A. S., Cruz C. A., Peixoto O. L. 1988. Decimations, extinctions and colonization of frog populations in southeast Brazil and their evolutionary implications. Biotropica, 20: 230–235

Hussain S. D., Gilani T., Khan A. R., Anwar M., Bokhari R. 2002. Population of migratory and resident species at Rawal Lake, Islamabad. Indus J Plant Sci, 1(3): 283–286

Khan M. S. 1969. A normal table of *Rana tigrina* Daudin. Early development (Stages 1–27). Pak J Sci, 21: 36–50

Khan M. S. 1973. Food of tiger frog *Rana tigerina* Daudin. Biology, 19: 93–107

Khan M. S. 1996. The oropharngeal morphology and feeding habits of tadpole of Tiger Frog *Rana tigerina* Daudin. Russ J Herpetol, 2: 163–171

Khan M. S. 2006. Amphibians, Chapter 3: Toads and Frogs. Amphibians and Reptiles of Pakistan. Malabar, Florida: Krieger Publishing Company, 42–67

Knapp R. A., Matthews K. R. 2000. Non-native fish introductions and the decline of the mountain yellow-legged frog from within protected areas. Conser Biol, 14: 428–438

McCallum M. L. 2007. Amphibian decline or extinction? Current declines dwarf background extinction rate. J Herpetol, 41(3): 483–491

Molur S. 2008. South Asian amphibians: Taxonomy, diversity and conservation status. Int Zool Yearbook. 42(1): 143–157

Pakistan Environmental Protection Agency (PEPA). 2004. Report on Rawal Lake catchment area monitoring operation. Islamabad: Pakistan Environmental Protection Agency, Ministry of Environment

Rombough C. J., Hayes M. P. 2007. *Rana boylii* (Foothill Yellow-legged Frog) Reproduction. Herpetol Rev, 38: 70–71

Sluys M. V., Rocha C. F. D., Souza M. B. 2001. Diet, reproduction, and density of the Leptodactylid Litter Frog *Zachaenus parvulus* in an Atlantic rain forest of southeastern Brazil. J Herpetol, 35 (2): 322–325

Yousaf S., Mahmood T., Rais M., Qureshi I. Z. 2010. Population variation and food habits of ranid frogs in the rice-based cropping system in Gujranwala region, Pakistan. Asian Herpetol Res. 1(2): 123–130

Wells K. D. 2007. Mating systems and sexual selection in anurans. In Wells K. D. (Ed.), The ecology and behavior of amphibians. Chicago, Illinois, USA: University of Chicago Press, 338–402